CONTRIBUTION OF ALASKAN, CANADIAN, AND TRANSBOUNDARY SOCKEYE SALMON STOCKS TO CATCHES IN SOUTHEAST ALASKA PURSE SEINE AND GILLNET FISHERIES, DISTRICTS 101–108, BASED ON ANALYSIS OF SCALE PATTERNS, 1998

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ABSTRACT

Sockeye salmon *Oncorhynchus nerka* harvested in southern Southeast Alaska's 1998 gillnet and purse seine fisheries were classified to nation and/or stock group of origin using linear discriminant function analysis of scale patterns and age composition data. A total of 918,534 sockeye salmon were harvested in these net fisheries in 1998, the seventh lowest harvest since scale analyses began in 1982. A total of 900,472 fish from this catch were classified to nation of origin. An estimated 237,132 fish (26%) were of Alaska origin, 635,492 fish (71%) were of Canadian origin, and 27,848 fish (3%) were of Transboundary origin. Separate Canadian stock contribution estimates (Nass River, Skeena River, and other south-migrating stocks) are presented for some districts. Stock contribution estimates are presented by age class and week for all major fisheries.

KEY WORDS: sockeye salmon, *Oncorhynchus nerka*, stock composition, linear discriminant function, scale pattern analysis, Southeast Alaska, Canada, Boundary Area

INTRODUCTION

Commercial net fisheries in southern Southeast Alaska harvest mixed stocks of sockeye salmon *Oncorhynchus nerka* that originate from lakes, rivers, and streams in Southeast Alaska and northern British Columbia (Rich and Morton 1930; Verhoeven 1952; Norenberg 1959; Logan 1967; Simpson 1968; Hoffman et al. 1983). The Alaska sockeye salmon originate primarily from numerous relatively low or moderately productive systems in the immediate vicinity (Figure 1). The Canadian sockeye salmon originate principally from the Nass and Skeena Rivers which lays entirely within British Columbia and flow into Chatham Sound just south of the Alaska border (Figure 2). Transboundary sockeye salmon, including Stikine River, Tahltan Lake, and Tuya Lake stocks, are typically found in identifiable numbers only in Districts 106 and 108. In some years south-migrating stocks of sockeye salmon, thought to be predominately bound for the Fraser River in southern British Columbia, may be caught in the District 104 purse seine fishery located along the outer coast just north of the Alaska-Canada border. Contributions of these south-migrating stocks are estimated separately in years when they are present in identifiable numbers. Rarely, a few sockeye salmon returning to northern Southeast Alaska and to systems as distant as Prince William Sound, Alaska, or Washington State may also be taken but their numbers are so few that separate contribution estimates of these stocks are not feasible.

The purpose of this study is to determine the national origin of major sockeye salmon stocks contributing to the 1998 commercial purse seine and gillnet fishery catches in Alaska Districts 101 through 108 (Figure 3). Reliable estimates of the relative Alaskan and Canadian stock compositions of sockeye salmon harvested in Southeast Alaska waters are valuable for implementation of the US/Canada Pacific Salmon Treaty. Calculation of national equity, or benefits equal to production, requires that accurate rates of interceptions of one nation's stocks by the other nation's fisheries be determined. This information is also useful for calculating productivity and for determining migratory timing and entry patterns.

Linear discriminant function analysis (Fisher 1936) is used for scale pattern analysis to estimate the origin of sockeye stocks taken in southern Southeast Alaska fisheries. Most sockeye salmon from Alaskan stocks grow slower during their lacustrine residence which results in scales with smaller freshwater growth zones and fewer circuli than scales from Canadian stocks. Persistent differences in the number and spacing of circuli in the spring plus growth and first marine zones also exist between Alaskan and Canadian stock groups. These differences in growth allow easy and accurate separation of Canadian and Alaskan stocks (Marshall et al. 1984). Significant and persistent differences between sockeye salmon stock groups originating in Alaska and Canada continue to be documented in the patterns of scale growth during freshwater and early marine life history (Oliver et al. 1984; Oliver and Walls 1985; Oliver and Jensen 1986; Oliver et al. 1987; Oliver Unpublished Report; Oliver and Farrington 1989; Oliver et al. 1990; Farrington and Oliver 1994; Farrington et al. 1995; Farrington et al. 1996a-c; Farrington et al. 1998; Farrington et al. 1999a-b). While the differences in scale patterns between Alaskan and Canadian stock groups is much greater than the differences within these groups, further separation of Canadian component stocks is possible.

METHODS

Numbers of Fish Caught

The number of fish harvested by gear type, district, and week were obtained from the ADF&G, Division of Commercial Fisheries, fish-ticket data base program *Alexander*; comprehensive data in the database dates back to 1960. Catches were summarized by statistical weeks, hereafter referred to as "weeks," which began on Sunday at 12:01 a.m. and ended the following Saturday at midnight. These weeks were numbered sequentially starting from the beginning of the calendar year.

Biological Data Collection and Processing

The ADF&G Region 1 port sampling project, in consultation with project biologists and biometricians, determined fish sampling goals required to achieve acceptable precision in the stock identification analyses. Temporal sampling strata were determined on the basis of catch and the rapidity of change in stock composition. In general, a sample of 520 fish per strata was sufficient to describe the sockeye age composition with a precision of $\pm$ 5% and a probability of 0.10 (Thompson 1987).

In 1998, commercial gillnet and purse seine landings of sockeye salmon in southern Southeast Alaska were sampled for scales by ADF&G Commercial Fisheries Division employees at fish processing facilities in Petersburg, Ketchikan, Craig, and Wrangell. Gender was determined and recorded for each fish sampled. Mid-eye to fork-of-tail length was recorded for 25% of the fish sampled (except for District 104 where length was recorded for 100% of the fish). Detailed age, gender, and length data for southern Southeast Alaska catches and escapements are not fully presented in this report.

Landings were sampled as representative as possible. Fish were sampled at random from deliveries at all major ports of landing and from multiple vessels and tenders. Deliveries with fish caught by mixed gear types or in mixed districts were not sampled.

Escapements to lake systems in southern Southeast Alaska were sampled by ADF&G Commercial Fisheries Division personnel. In northern British Columbia, scales were collected from test fisheries operating near or in the lower reaches of the Skeena River by Canadian Department of Fisheries and Oceans (CDFO) personnel, and in the Nass River by LGL Ltd. personnel under contract to the Nisga'a First Nation in British Columbia, Canada. The Pacific Salmon Commission (PSC) provided commercial catch samples from purse seine fisheries in British Columbia and Washington State waters judged to be representative of south migrating sockeye salmon stocks.

Scales were sampled from the preferred area above the lateral line on the left side of the fish on a diagonal downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). Scales were mounted on gum cards and impressions made in cellulose acetate (Clutter and Whitesel 1956). Age determinations were based on examinations of scales under moderate (70 power) magnification. Criteria used to assign ages were similar to those of Mosher (1968), and ages reported in European notation (Koo 1962).

Digitizing of Scales

Scale circuli were counted and incremental distances measured or *digitized* according to zones that represent life history stages of the fish (Figure 4). Scale impressions were projected onto a digitizing tablet at 100 power magnification using equipment similar to that described by Ryan and Christie (1976). Counts and measurements were made on a selected radius along or near the longest axis of the scale (Anas and Murai 1969), which is perpendicular to the dorsal transition zone between anterior and posterior portions of the scale and/or at 20 degrees from the dorsal line of circuli breakage in the anterior portion. A series of counts and measurements unique to a given scale were referred to as *raw* digitized data. In aggregate, raw digitized data was transformed to summarized data - a set of 33 discrete measurements or counts, i.e., the discrete scale variables (Appendix A1).

Discriminant Analysis

The ability to differentiate salmon stocks based on scale patterns depends upon the degree of difference in the scale characters between stocks. Linear discriminant function analysis (LDF) of scale patterns has been used to estimate stock contributions to southern Southeast Alaska mixed stock sockeye salmon fisheries since 1982. The major assumptions underlying LDF analysis are: 1) the groupings investigated are discrete and identifiable; 2) the parent distributions of the measured variables are multivariate normal; and 3) the variance-covariance matrices for all groups are equal. Gilbert (1969) found LDF satisfactory if the variance-covariance matrices were not too different. In addition, large sample sizes appear to make LDF robust to the assumption of common variance-covariance matrices (Issacson 1954). The method also appears to be robust to violations of the normality assumption for discrete distributions; however, it is not robust for continuous non-Gaussion parent distributions (Lachenbruch et al. 1973; Krzanowski 1977)

The statistical program SAS was utilized by ADF&G personnel to perform the LDF procedures (Figure 5). The analyses were in the form of age-specific models; building an LDF model began with initial selection of the potential length and scale variables, made with a stepwise discriminant analysis of a pooled standard assembled from the escapements (only in District 104 was length included as a variable additional to digitized scale variables as it provided further discriminating power in separating South-migrating sockeye salmon stocks). In the next step of the model-building process, discriminant analysis of the pooled standards was performed in an iterative fashion by variable. Up to 14 of the initially selected variables were entered sequentially into the LDF model or until the partial F-statistic of a variable available for entry into the model was less than 4.0. The successive classification accuracies which resulted were plotted against the respective variables. Variables were included in the model until accuracy peaked or became asymptotic for up to a total of twelve variables.

Fish in a mixed stock composition sample were classified to stock of origin by a discriminant rule generated from an LDF model. An almost unbiased estimate of classification accuracy for each LDF model was determined with a cross validation procedure similar to a leaving-one-out procedure (Lachenbruch 1967). Also, the estimates of stock composition proportions in the mixed stock harvest, referred to as first order estimates, were adjusted with a classification matrix correction procedure (Cook and Lord 1978). Estimates were constrained with a maximum likelihood procedure so adjusted estimated proportions for a stock group may be equal to or greater than zero.

The variance and 90% confidence intervals of the adjusted estimates of stock proportions were computed according to Pella and Robertson (1979). The variance-covariance matrices for the misclassification matrix and for the mixed stock proportion vector were determined from the multinomial probability distribution. These two variance-covariance matrices were combined to give variances and covariances for the second order estimates of stock proportions. The variances for the proportions of each stock were the diagonal elements of this combined matrix, i.e., they were an additive combination of: 1) the sampling variation in estimation of the probability of assignment of the known stock group and 2) the sampling variation in estimation of the assignment composition of the mixed stock group.

Classification of Catches

The commercial catches were classified by stock composition based on standards assembled from 1998 escapements. Analyzing up to 100 scales per strata for each of the major age classes allowed estimates of stock proportions with a precision of $\pm$ 10% with probability of 0.10. The four major age groups, 1.2, 1.3, 2.2, and 2.3 generally contribute more than 98% of the commercial catches. The stock apportionment of the minor age classes not classified assumes that the proportion of the minor ages belonging to any given stock is equal to the combined proportion of all classified age classes. Age specific models were used in the analysis to: 1) account for differences in age composition between stocks, 2) remove potential bias due to differences in migratory timing of different age fish, and 3) eliminate the effect of different environmental conditions on the scale patterns of different age fish. Stock contributions were estimated for each week to track temporal patterns.

The variance of the weekly and seasonal stock composition estimates were approximated with the delta method (Seber 1982). Variance estimates were functions of the variances associated with the weekly: 1) estimated age composition of the catch, 2) age specific stock composition estimates, 3) sample size of the age composition, and 4) catch size. Use of a maximum likelihood procedure to constrain the stock proportion estimates did provide a variance estimate for stock(s) contributing zero fish.

RESULTS

National Origin of Southern Southeast Sockeye Salmon Catches

The total sockeye salmon harvest in the southern Southeast (Districts 101–108) seine and gillnet fisheries in 1998 was 918,534 fish. For many of the net fisheries of southern Southeast Alaska, the catch was identified by nation of origin (Table 1). Out of 900,472 fish identified, the estimated U.S. component was 237,132 fish (26%), while the estimated Canada component was 635,492 fish (71%). The estimated Transboundary component was 27,848 fish, 3% of the total.

Stock Composition of Southern Southeast Sockeye Salmon Catches

The total of sockeye salmon identified by stock grouping was 1,792,963 fish (Table 2). Of these, it was estimated that: 431,504 fish (24%) were of Alaska origin; 433,723 fish (24%) were Nass River origin; 617,612 (34%) were Skeena River origin; 208,866 (12%) were south-migrating stock origin (primarily Fraser River); 43,408 (3%) were transboundary Tahltan Lake origin; 20,330 (1%) were transboundary Stikine River origin; and 37,520 (2%) were transboundary Tuya Lake origin.

Sockeye salmon escapement to southern Southeast is crudely indexed by peak counts made during escapement surveys; year to year consistency (temporal or spatial) is not strictly maintained in these surveys. Escapement to selected systems throughout Districts 101–108 totaled 105,035 fish (a partial listing of the contributing stocks can be found in Figure 1). The escapement of sockeye salmon to Canada's Nass River system (CDFO Area 3) was 266,463 fish excluding the in-river catch, with a total run size of 718,389 (**preliminary** estimates provided by the PSC Northern Boundary Technical Committee). The escapement to Canada's Skeena River system (CDFO Area 4) was 585,899 fish excluding the in-river catch, with a total run size of 1,006,898 (**preliminary** estimates provided by the PSC Northern Boundary Technical Committee). The Fraser River system was estimated to have had a spawning escapement of 4,424,596 sockeye salmon and an overall run size of 10,873,043 (personal communication with the Pacific Salmon Commission).

District 101-11 Gillnet Stock Composition

Weekly stock composition estimates comprised Alaska, Nass, and Skeena stock groupings. Of the season catch of 160,506 sockeye salmon, the estimated stock contributions were: 15,884 fish from the Alaska stock grouping for 10% of the total; 104,202 Nass River fish (65%); and 40,420 Skeena River fish (25%) (Table 3). Nass was the largest stock component in the catches from weeks 25 through 28 and from weeks 30 through all weekly strata. This is the fourth lowest percentage contribution Alaska has made to the fishery since analyses began in 1982.

District 101 Purse Seine Stock Composition

Weekly and stock composition estimates comprised Alaska, Nass, and Skeena stock groupings. Early and late weekly strata were combined due to low sample sizes. Exclusive of 20,719 McDonald Lake fish (Alaska stock grouping) caught in the Yes Bay terminal fisheries, the season catch total was 49,682 sockeye. The estimated stock contributions were 26,766 fish from the Alaska stock grouping (54%), 14,040 Nass River fish (28%), and 8,876 Skeena River fish (18%) (Table 4). Alaska was the largest stock component in all time period strata except the stratum composed of weeks 28–30.

District 102 Purse Seine Stock Composition

Stock composition estimates were made on a combined week basis for Alaska, Nass, and Skeena stock groupings. Of the catch of 29,414 sockeye salmon through week 40, the estimated stock contributions were: 23,111 fish from the Alaska stock grouping for 79% of the total; 2,652 Nass River fish (9%); and 3,651 Skeena River fish (12%) (Table 5).

District 103 Purse Seine Stock Composition

There was insufficient sample size to make a direct estimate of stock composition for this district.

District 104 Purse Seine Stock Composition

Weekly stock compositions comprised Alaska, Nass, Skeena, and south-migrating groupings. Of the season total of 487,230 sockeye salmon caught, the estimated stock contributions were: 65,348 fish from the Alaska stock grouping (13%); 122,603 Nass River fish (25%); 100,167 Skeena River fish (21%); and 199,112 (41%) fish from the south-migrating stock grouping (Table 6). Nass was the dominant component in the fishery for weeks 28, 29, and 30 (weeks 28 and 29 were grouped into one stratum). Skeena was the largest contributing stock in week 30. South-migrating was the largest stock group present in weeks 32–35, and contributed 41% of the sockeye salmon to the fishery as a whole, the largest proportion attributed to a single stock group.

District 106 and 108 Gillnet Stock Composition

A total of 113,435 sockeye salmon were caught in the 106 gillnet fishery and 22,031 sockeye salmon were caught in the 108 gillnet fishery. These are relatively low catches compared to catches in recent years (Table 1). Alaska contributed 67,890 fish (60%) to the 106 gillnet fishery and 2,541 fish (12%) to the 108 gillnet fishery. Canadian stocks contributed 34,811 (31%) fish to the 106 gillnet fishery and 2,376 (11%) to 108 gillnet. Transboundary stocks contributed 10,734 (9%) fish to 106 gillnet and 17,114 (78%) to 108 gillnet. The reader is referred to Jensen and Frank (in press) for the weekly stock compositions of the fisheries in these two districts.

DISCUSSION

The sockeye salmon catch in the boundary area net fisheries in 1998 was below average compared to recent years and is ranked 10th in magnitude when compared to the previous 17 years when SPA analyses have been conducted (Table 1). Catches were about average in the District 101–103 seine fisheries and in the District 101 gillnet fishery, but were below average for the fisheries that focus on transboundary stocks in Districts 106 and 108. The catch in the District 104 seine fishery was also below average, with a relatively high contribution (41%) from South-migrating stocks (predominately Fraser River) that sometimes make large contributions to this fishery. The overall Skeena run size (based upon preliminary estimates provided by the Northern Boundary Technical Committee) was the lowest since SPA analyses began in 1982 and the Nass run size was the 9th largest for this same time period. The portion of fish from the Nass and Skeena runs that were caught in the southern Southeast fisheries was above average considering these relatively low run sizes. However, the overall U.S.:Canada sockeye salmon catch ratio, 23:71, for these fisheries was near average for the 17 years of available SPA data (Table 1).

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Table 1. Estimated sockeye salmon contributions by nation of origin to southern Southeast Alaska's Districts 101–108 net fisheries, 1982 to 1998.

		1982		1983		1984		1985		1986		1987	
Fishery	Group	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
101-11	US	69,483	36	48,905	36	34,843	39	30,946	18	12,738	9	25,073	23
Gillnet	Canada	121,325	64	86,998	64	53,588	61	142,154	82	132,961	91	82,430	77
	Total	190,808		135,903		88,431		173,100		145,699		107,503	
101[a]	US	39,518	56	20,376	43	49,348	60	82,311	69	50,313	67	30,071	69
P. Seine	Canada	30,941	44	27,263	57	32,537	40	37,159	31	24,510	33	13,233	31
	Total	70,459		47,639		81,885		119,470		74,823		43,304	
102	US	18,672	80	6,482	59	17,857	82	28,417	78	24,030	73	16,211	94
P. Seine	Canada	4,542	20	4,498	41	3,808	18	7,887	22	8,681	27	1,064	6
	Total	23,214		10,980		21,665		36,304		32,711		17,275	
103	US			7,098	68			19,560	74	9,883	72	1,401	98
P. Seine	Canada			3,357	32			6,703	26	3,806	28	34	2
	Total			10,455				26,263		13,689		1,435	
104	US	106,786	38	155,967	24	78,954	27	94,005	22	101,121	23	68,647	40
P. Seine	Canada	176,572	62	487,301	76	215,208	73	337,648	78	343,550	77	102,332	60
	Total	283,358		643,268		294,162		431,653		444,671		170,979	
106	US	94,320	49	32,583	67	60,597	66	126,914	48	100,268	69	112,893	83
Gillnet	Canada	62,063	32	10,582	22	24,755	27	111,017	42	42,756	29	21,190	15
	Transboundary	37,418	19	5,580	11	6,787	7	27,056	10	2,685	2	2,344	2
	Total	193,801		48,842		92,139		264,987		145,709		136,427	
108	US	1,784	25							930	22		
Gillnet	Canada	4,139	58							73	2		
	Transboundary	1,213	17							3,184	76		
	Total	7,136								4,185			
	US	330,562	43	271,411	30	241,599	42	382,152	36	299,284	35	254,296	53
Total	Canada	399,583	52	619,998	69	329,896	57	642,569	61	556,336	64	220,283	46
	Transboundary	38,631	5	5,580	1	6,787	1	27,056	3	5,869	1	2,344	1
	Total	768,776		896,989		578,282		1,051,777		861,489		476,923	

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Fishery	Group	1988 Number	1988 %	1989 Number	1989 %	1990 Number	1990 %	1991 Number	1991 %	1992 Number	1992 %
101-11	US	14,796	13	31,406	22	13,862	16	13,599	10	49,771	20
Gillnet	Canada	101,319	87	113,530	78	71,829	84	117,893	90	194,878	80
	Total	116,115		144,936		85,691		131,492		244,649	
101[a]	US	12,799	41	37,236	32	29,498	51	34,193	57	83,065	74
P. Seine	Canada	18,340	59	80,622	68	27,809	49	26,227	43	28,954	26
	Total	31,139		117,858		57,307		60,420		112,019	
102	US	10,347	70	35,807	62	38,384	75	32,413	75	30,075	90
P. Seine	Canada	4,455	30	21,834	38	12,838	25	10,841	25	3,377	10
	Total	14,802		57,641		51,222		43,254		33,452	
103	US	790	33	20,551	96	14,226	74	13,867	74	3,277	74
P. Seine	Canada	1,587	67	936	4	5,124	26	4,995	26	1,180	26
	Total	2,377		21,487		19,350		18,862		4,457	
104	US	104,042	18	73,026	14	123,420	15	166,794	20	198,080	18
P. Seine	Canada	487,243	82	443,575	86	673,378	85	683,037	80	873,959	82
	Total	591,285		516,601		796,798		849,831		1,072,039	
106	US	80,868	87	126,603	66	112,983	61	78,577	55	120,977	60
Gillnet	Canada	9,784	11	59,959	31	68,921	37	47,695	33	47,207	23
	Transboundary	1,877	2	6,172	3	3,901	2	17,832	12	34,971	17
	Total	92,529		192,734		185,805		144,104		203,155	
108	US	265	21	1,180	12	4,576	40	3,116	17	8,604	16
Gillnet	Canada	48	4	545	5	1,479	13	2,117	12	2,696	5
	Transboundary	933	75	8,358	83	5,519	48	12,754	71	41,417	79
	Total	1,246		10,083		11,574		17,987		52,717	
	US	223,907	27	325,809	31	336,949	28	342,560	27	493,849	29
Total	Canada	622,776	73	721,001	68	861,378	71	892,804	71	1,152,251	67
	Transboundary	2,810	0	14,530	1	9,420	1	30,585	2	76,388	4
	Total	849,493		1,061,340		1,207,747		1,265,950		1,722,488	

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Table 1. (page 3 of 3)

Fishery	Group	1993 Number	1993 %	1994 Number	1994 %	1995 Number	1995 %	1996 Number	1996 %	1997 Number	1997 %	1998 Number	1998 %
101-11	US	42,337	11	14,008	14	13,056	8	29,745	14	32,028	19	15,884	10
Gillnet	Canada	351,761	89	86,369	86	151,238	92	182,658	86	137,446	81	144,622	90
	Total	394,098		100,377		164,294		212,403		169,474		160,506	
101[a]	US	246,662	75	18,991	33	63,279	29	396,178	89	84,519	80	47,485	67
P. Seine	Canada	83,820	25	39,100	67	154,699	71	47,653	11	21,691	20	22,916	33
	Total	330,482		58,091		217,978		443,831		106,210		70,401	
102	US	115,916	94	18,521	65	56,518	77	60,026	90	45,908	84	23,111	79
P. Seine	Canada	7,991	6	10,158	35	16,907	23	6,767	10	8,503	16	6,303	21
	Total	123,907		28,679		73,425		66,793		54,411		29,414	
103	US	37,251	74	11,242	74	7,532	74	24,009	99	24,666	82	14,873	85
P. Seine	Canada	13,419	26	4,050	26	2,713	26	178	1	5,306	18	2,582	15
	Total	50,670		15,292		10,245		24,187		29,972		17,455	
104	US	205,108	22	212,854	19	68,952	14	209,567	24	210,524	17	65,348	13
P. Seine	Canada	740,177	78	923,284	81	428,193	86	650,872	76	1,034,156	83	421,882	87
	Total	945,285		1,136,138		497,145		860,439		1,244,680		487,230	
106	US	82,301	40	122,118	58	65,544	32	165,221	53	97,101	58	67,890	60
Gillnet	Canada	69,616	34	53,683	25	116,075	56	83,271	27	45,665	27	34,811	31
	Transboundary	54,038	26	35,247	17	25,679	12	62,608	20	25,752	15	10,734	9
	Total	205,955		211,048		207,298		311,100		168,518		113,435	
108	US	17,758	23	31,715	33	10,374	14	15,755	10	5,381	6	2,541	12
Gillnet	Canada	8,742	11	20,250	21	15,641	20	12,618	8	12,152	13	2,376	11
	Transboundary	50,374	66	45,259	47	50,741	66	125,777	82	75,506	81	17,114	78
	Total	76,874		97,224		76,756		154,150		93,039		22,031	
	US	747,333	35	429,450	26	285,255	23	900,501	43	500,127	27	237,132	26
Total	Canada	1,275,526	60	1,136,893	69	885,466	71	984,017	48	1,264,919	68	635,492	71
	Transboundary	104,412	5	80,506	5	76,420	6	188,385	9	101,258	5	27,848	3
	Total	2,127,271		1,646,849		1,247,141		2,072,903		1,866,304		900,472	

a. Includes fish caught in the Yes Bay (West Behm Canal) terminal area fisheries.

Table 2. Estimated contribution by stock group of origin of sockeye salmon harvested in the net fisheries in Alaska's Districts 101–108, 1998.

District	Type	Group	Estimated Number	Percent	Standard Error	90% C.I. Lower	90% C.I. Upper
101	Gillnet	Alaska	15,884	10	1837.5	12,861	18,907
		Nass	104,202	65	4357.6	97,034	111,370
		Skeena	40,420	25	4357.0	33,253	47,587
		Total	160,506				
101	Purse seine	Alaska	26,766	54	1008.7	25,107	28,425
		Nass	14,040	28	1366.2	11,793	16,287
		Skeena	8,876	18	1334.5	6,681	11,071
		Total	49,682				
102	Purse seine	Alaska	23,111	79	1167.0	21,191	25,031
		Nass	2,652	9	2302.8	0	6,440
		Skeena	3,651	12	2297.0	0	7,430
		Total	29,414				
104	Purse seine	Alaska	65,348	13	9995.0	48,906	81,790
		Nass	122,603	25	20859.2	88,290	156,916
		Skeena	100,167	21	18420.5	69,865	130,469
		S. migrating	199,112	41	9851.3	182,907	215,317
		Total	487,230				
106	Gillnet	Alaska I	47,921	42	1855.3	44,869	50,973
		Alaska II	19,969	18	1263.7	17,890	22,048
		Nass	13,891	12	1666.5	11,150	16,632
		Skeena	20,920	18	1855.5	17,868	23,972
		Tahltan	1,678	1	1159.8	0	3,586
		Stikine	36	0	985.0	0	1,656
		Tuya	9,020	8	982.8	7,403	10,637
		Total	113,435				
108	Gillnet	Alaska I	2,398	11	439.3	1,675	3,121
		Alaska II	143	1	211.7	0	491
		Nass	1,426	6	523.3	565	2,287
		Skeena	950	4	712.8	0	2,123
		Tahltan	4,170	19	417.4	3,483	4,857
		Stikine	7,561	34	463.5	6,799	8,323
		Tuya	5,383	24	534.6	4,504	6,262
		Total	22,031				
All Districts		Alaska	201,540	23	10532.4	184,214	218,866
		Nass	258,814	30	21548.0	223,368	294,260
		Skeena	174,984	20	19217.3	143,371	206,597
		S. migrating	199,112	23	9851.3	182,907	215,317
		Tahltan	5,848	1	1232.6	3,820	7,876
		Stikine	7,597	1	1088.6	5,806	9,388
		Tuya	14,403	2	1118.8	12,563	16,243
		Total	862,298				

[a] The total sockeye salmon catch for the District 101 purse seine fishery was 70,401 fish, of which 20,719 were taken in the terminal fisheries at Yes Bay; the remainder was 49,682 fish.

Table 3. Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 101–11 drift gillnet fishery, 1998.

		Catch By Age Class							Standard	90% C.I.	
Dates	Group	1.2	1.3	2.2	2.3	Other	Total	Percent	Error	Lower	Upper
6/21-6/27	Alaska	37	0	0	193	7	237	1	299.7	0	730
Week 26	Nass	2,969	6,675	3,657	712	411	14,424	87	958.9	12,847	16,001
	Skeena	0	1,797	0	0	53	1,850	11	961.2	269	3,431
	Total	3,006	8,472	3,657	905	471	16,511				
6/28-7/04	Alaska	66	0	469	435	9	979	3	617.7	0	1,995
Week 27	Nass	5,314	13,143	5,795	1,608	232	26,092	85	1892.1	22,979	29,205
	Skeena	0	3,539	0	0	32	3,571	12	1889.3	463	6,679
	Total	5,380	16,682	6,264	2,043	273	30,642				
7/05-7/11	Alaska	26	0	783	464	13	1,286	5	619.3	267	2,305
Week 28	Nass	3,203	9,984	5,276	1,713	211	20,387	72	1801.1	17,424	23,350
	Skeena	300	6,427	0	0	70	6,797	24	1820.4	3,802	9,792
	Total	3,529	16,411	6,059	2,177	294	28,470				
7/12-7/18	Alaska	295	1,023	275	580	58	2,231	15	436.6	1,513	2,949
Week 29	Nass	955	3,289	2,627	1,092	214	8,177	57	899.3	6,698	9,656
	Skeena	12	3,922	0	0	106	4,040	28	905.1	2,551	5,529
	Total	1,262	8,234	2,902	1,672	378	14,448				
7/19-7/25	Alaska	392	2,352	347	1,565	150	4,806	16	1008.0	3,148	6,464
Week 30	Nass	1,267	5,993	3,367	2,949	438	14,014	46	2058.8	10,627	17,401
	Skeena	16	11,094	0	0	358	11,468	38	2127.1	7,969	14,967
	Total	1,675	19,439	3,714	4,514	946	30,288				

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Table 3. (page 2 of 2)

Dates	Group	Catch By Age Class 1.2	1.3	2.2	2.3	Other	Total	Percent	Standard Error	90% C.I. Lower	Upper
7/26-8/01	Alaska	176	1,096	368	747	12	2,399	13	549.7	1,495	3,303
Week 31	Nass	569	4,146	3,572	1,378	47	9,712	54	1211.3	7,719	11,705
	Skeena	7	5,960	0	0	29	5,996	33	1242.8	3,952	8,040
	Total	752	11,202	3,940	2,125	88	18,107				
8/02-8/08	Alaska	162	1,010	242	698	20	2,132	16	370.2	1,523	2,741
Week 32	Nass	525	1,880	3,762	1,288	72	7,527	57	692.4	6,388	8,666
	Skeena	7	3,477	0	0	34	3,518	27	697.6	2,370	4,666
	Total	694	6,367	4,004	1,986	126	13,177				
8/09-8/15	Alaska	18	200	44	103	3	368	17	67.5	257	479
Week 33	Nass	58	247	504	191	7	1,007	47	123.4	804	1,210
	Skeena	1	745	0	0	5	751	35	128.5	540	962
	Total	77	1,192	548	294	15	2,126				
8/16-9/26	Alaska	74	1,021	87	250	14	1,446	22	244.8	1,043	1,849
Weeks	Nass	104	647	1,435	648	28	2,862	42	391.4	2,218	3,506
34-39	Skeena	78	2,327	0	0	24	2,429	36	411.3	1,752	3,106
	Total	256	3,995	1,522	898	66	6,737				
	Alaska	1,246	6,702	2,615	5,035	286	15,884	10	1837.5	12,861	18,907
Fishery	Nass	14,964	46,004	29,995	11,579	1,660	104,202	65	4357.6	97,034	111,370
Total	Skeena	421	39,288	0	0	711	40,420	25	4357.0	33,253	47,587
	Total	16,631	91,994	32,610	16,614	2,657	160,506				

Table 4. Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 101 purse seine fishery, 1998.

		Catch By Age Class							Standard	90% C.I.	
Dates	Group	1.2	1.3	2.2	2.3	Other	Total	Percent	Error	Lower	Upper
7/5-7/25	Alaska	334	2816	531	652	126	4,459	33	520.6	3,603	5,315
Week	Nass	855	3384	2059	406	195	6,899	51	855.7	5,491	8,307
28-30	Skeena	73	2067	0	0	62	2,202	16	807.0	874	3,530
	Total	1262	8267	2590	1058	383	13,560				
7/26-8/1	Alaska	666	3833	1005	492	248	6,244	68	342.2	5,681	6,807
Week 31	Nass	292	522	706	306	76	1,902	21	419.8	1,211	2,593
	Skeena	183	824	0	0	42	1,049	11	373.9	434	1,664
	Total	1141	5179	1711	798	366	9,195				
8/2-8/8	Alaska	473	6868	1098	540	252	9,231	71	541.7	8,340	10,122
Week 32	Nass	208	0	1077	336	45	1,666	13	611.2	661	2,671
	Skeena	130	1992	0	0	60	2,182	17	629.7	1,146	3,218
	Total	811	8860	2175	876	357	13,079				
8/9-9/5	Alaska	1154	3619	1032	908	119	6,832	49	550.0	5927	7737
Weeks	Nass	244	1156	1632	479	62	3,573	26	743.4	2350	4796
33-36	Skeena	33	3350	0	0	60	3,443	25	764.9	2185	4701
	Total	1431	8125	2664	1387	241	13,848				
	Alaska	2,627	17,136	3,666	2,592	745	26,766	54	1008.7	25,107	28,425
Fishery	Nass	1,599	5,062	5,474	1,527	378	14,040	28	1366.2	11,793	16,287
Total	Skeena	419	8,233	0	0	224	8,876	18	1334.5	6,681	11,071
	Total	4,645	30,431	9,140	4,119	1,347	49,682				

[a] These District 101 seine catches do not include the 20,719 sockeye caught in west Behm Canal. Sub-districts 80, 85, 90 and 95 are considered part of a "terminal area" dominated by Alaskan fish.

Table 5. Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 102 purse seine fishery, 1998.

		Catch By Age Class							Standard	90% C.I.	
Dates	Group	1.2	1.3	2.2	2.3	Other	Total	Percent	Error	Lower	Upper
7/5-10/3	Alaska	3,402	15,996	2,003	1,208	502	23,111	79	1167.0	21,191	25,031
Weeks	Nass	946	0	1,130	518	58	2,652	9	2302.8	0	6,440
28 - 40	Skeena	0	3,572	0	0	79	3,651	12	2297.0	0	7,430
	Total	4,348	19,568	3,133	1,726	639	29,414				
	Alaska	3,402	15,996	2,003	1,208	502	23,111	79	1167.0	21,191	25,031
Fishery	Nass	946	0	1,130	518	58	2,652	9	2302.8	0	6,440
Total	Skeena	0	3,572	0	0	79	3,651	12	2297.0	0	7,430
	Total	4,348	19,568	3,133	1,726	639	29,414				

[a] All weeks are pooled due to small sample sizes in individual strata.

Table 6. Estimated contribution of sockeye salmon stocks originating in Alaska and Canada to Alaska's District 104 purse seine fishery, 1998.

		Catch By Age Class							Standard	90% C.I.	
Dates	Group	1.2	1.3	2.2	2.3	Other	Total	Percent	Error	Lower	Upper
7/5-7/18	Alaska	396	1,565	387	155	74	2,577	33	284.1	2,110	3,044
Weeks	Nass	140	1,724	711	520	95	3,190	40	476.5	2,406	3,974
28-29	Skeena	163	1,745	0	0	58	1,966	25	462.6	1,205	2,727
	SM[a]	144	21	5	0	4	174	2	63.9	69	279
	Total	843	5,055	1,103	675	231	7,907				
7/19-7/25	Alaska	451	1,693	289	94	69	2,596	27	360.8	2,002	3,190
Week 30	Nass	287	1,757	789	315	86	3,234	34	633.0	2,193	4,275
	Skeena	110	3,265	0	0	94	3,469	37	643.4	2,411	4,527
	SM[a]	139	47	0	1	1	188	2	95.9	30	346
	Total	987	6,762	1,078	410	250	9,487				
7/26-8/1	Alaska	636	4,807	1,840	666	141	8,090	19	1300.6	5,951	10,229
Week 31	Nass	410	8,554	6,739	2,229	318	18,250	44	2507.7	14,125	22,375
	Skeena	1,356	11,143	0	0	222	12,721	31	2481.1	8,640	16,802
	SM[a]	1,898	648	0	18	16	2,580	6	574.8	1,635	3,525
	Total	4,300	25,152	8,579	2,913	697	41,641				
8/2-8/8	Alaska	7,638	15,942	2,308	3,389	463	29,740	12	6570.0	18,932	40,548
Week 32	Nass	0	29,376	14,920	5,115	900	50,311	20	14035.6	27,222	73,400
	Skeena	0	53,785	0	0	912	54,697	22	12980.6	33,344	76,050
	SM[a]	85,447	29,160	0	802	732	116,141	46	8493.0	102,170	130,112
	Total	93,085	128,263	17,228	9,306	3,007	250,889				

Table 6. (Page 2 of 2)

Dates	Group	Catch By Age Class 1.2	1.3	2.2	2.3	Other	Total	Percent	Standard Error	90% C.I. Lower	Upper
8/9-8/15	Alaska	1,166	6,424	897	5,169	206	13,862	12	6209.9	3,647	24,077
Week 33	Nass	0	17,904	5,797	7,802	533	32,036	27	13348.1	10,078	53,994
	Skeena	2,497	12,276	0	0	311	15,084	13	11162.9	0	33,447
	SM[a]	41,189	14,056	0	386	353	55,984	48	4470.1	48,631	63,337
	Total	44,852	50,660	6,694	13,357	1,403	116,966				
8/16-8/29	Alaska	3,041	3,527	427	1,371	117	8,483	14	3246.1	3,143	13,823
Weeks	Nass	0	10,481	2,763	2,069	269	15,582	26	6876.5	4,270	26,894
34-35	Skeena	813	11,221	0	0	196	12,230	20	6279.0	1,901	22,559
	SM[a]	17,690	6,037	0	166	152	24,045	40	2143.1	20,520	27,570
	Total	21,544	31,266	3,190	3,606	734	60,340				
	Alaska	13,328	33,958	6,148	10,844	1,070	65,348	13	9995.0	48,906	81,790
Fishery	Nass	837	69,796	31,719	18,050	2,201	122,603	25	20859.2	88,290	156,916
Total	Skeena	4,939	93,435	0	0	1,793	100,167	21	18420.5	69,865	130,469
	SM[a]	146,507	49,969	5	1,373	1,258	199,112	41	9851.3	182,907	215,317
	Total	165,611	247,158	37,872	30,267	6322	487,230				

[a] South-migrating (mostly of Fraser origin). Numbers of south-migrating fish of age classes other than 1.2 are estimated from age composition proportions provided by the Pacific Salmon Commission. The standard errors are minimum estimates computed only for the 1.2 age class which was estimated directly through SPA.

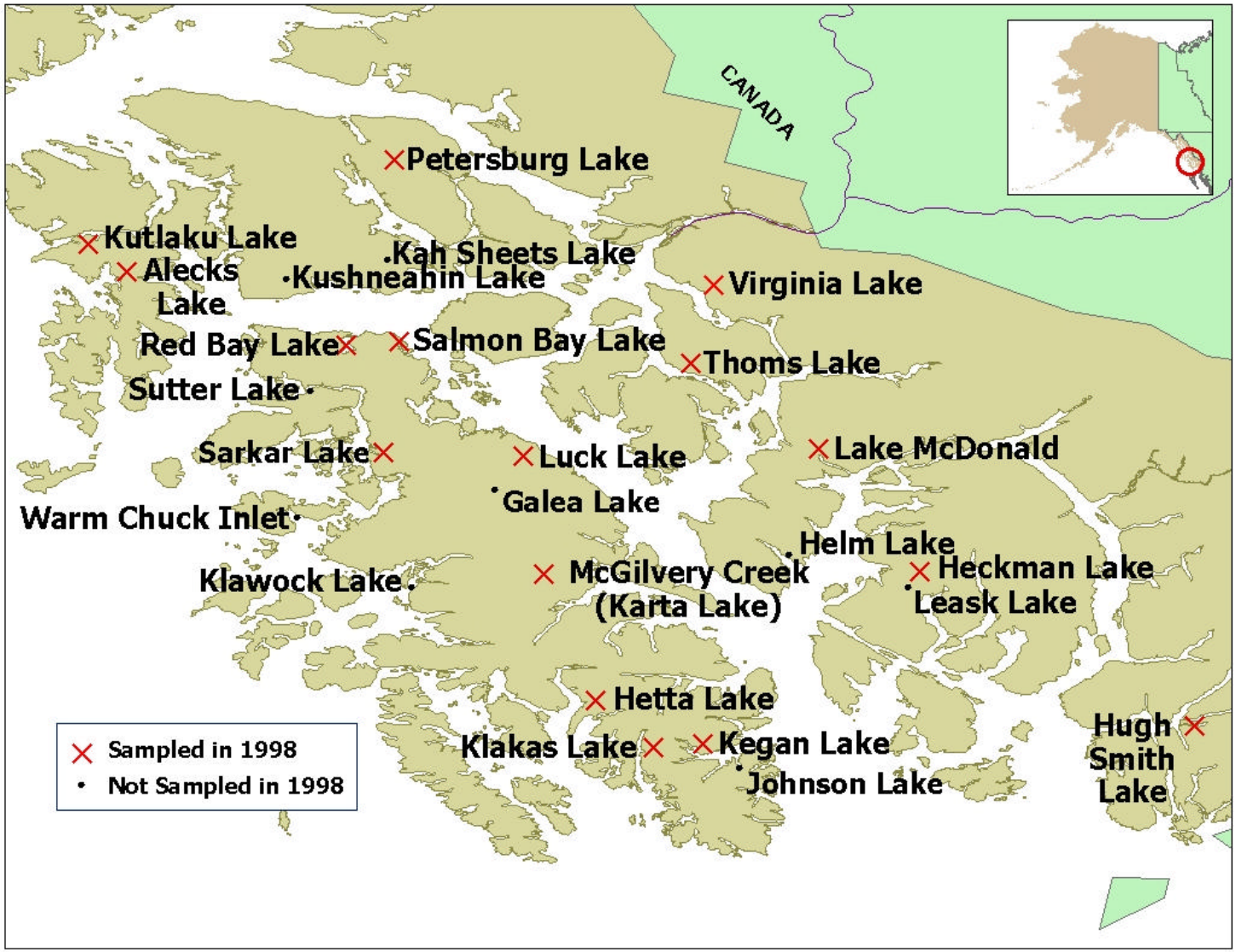

Figure 1. Major sockeye salmon systems of Southeast Alaska and the transboundary Stikine; points identify Alaska systems where scales are commonly collected, while 'X' identifies stocks sampled in 1998.

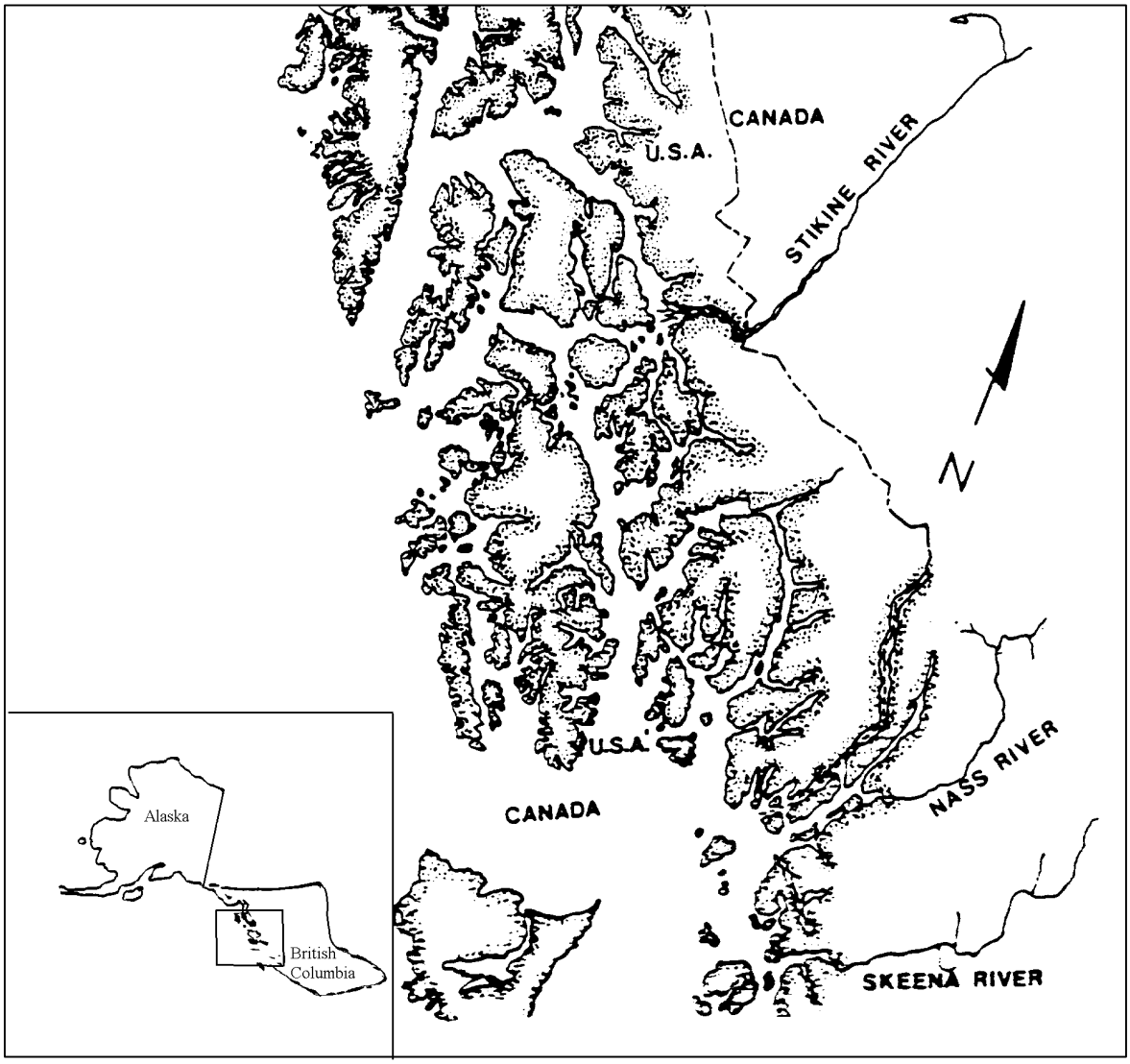

Figure 2. The Canadian Nass and Skeena Rivers and the transboundary Stikine River.

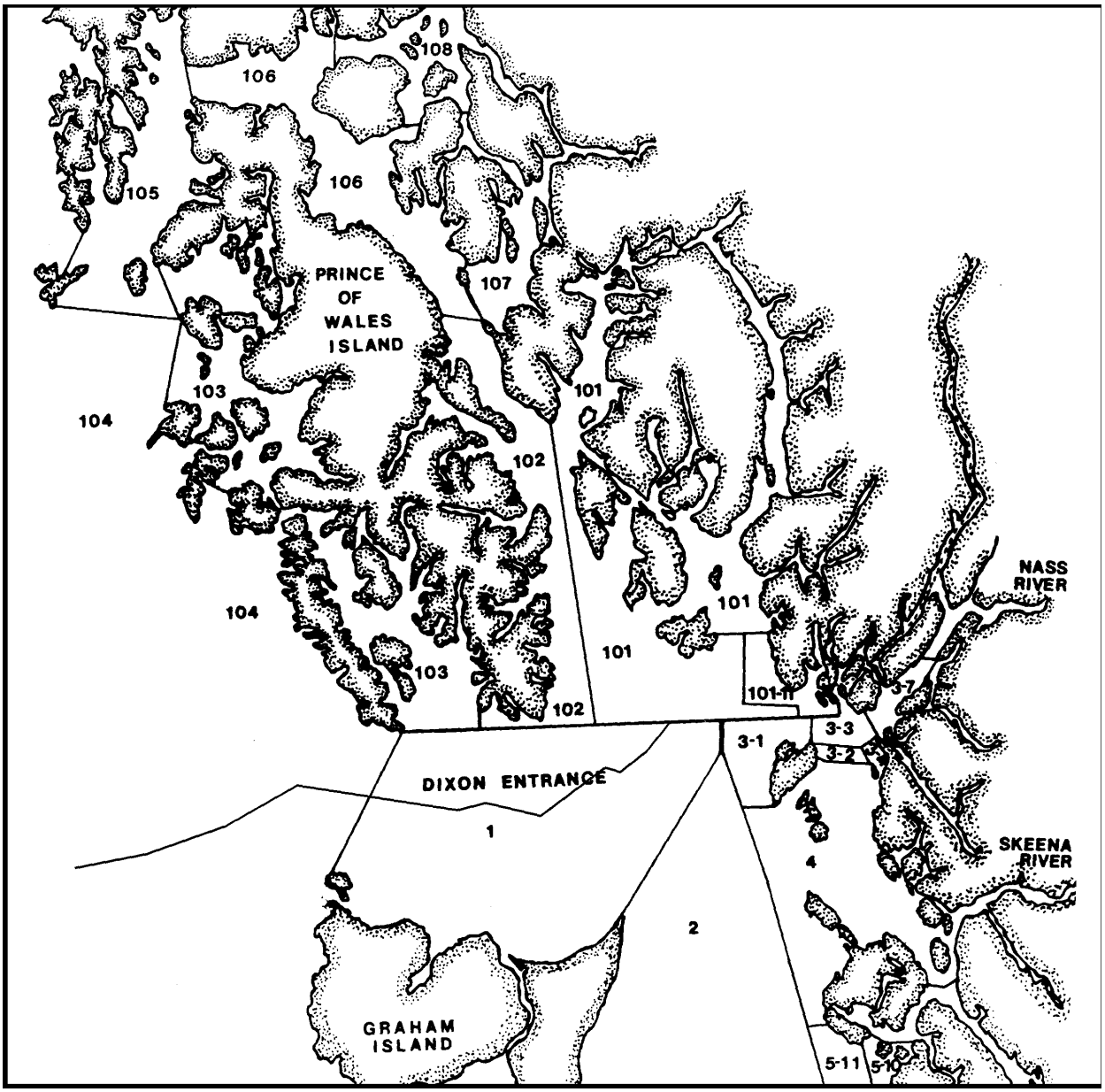

Figure 3. Fishery management districts in southern Southeast Alaska and northern British Columbia waters.

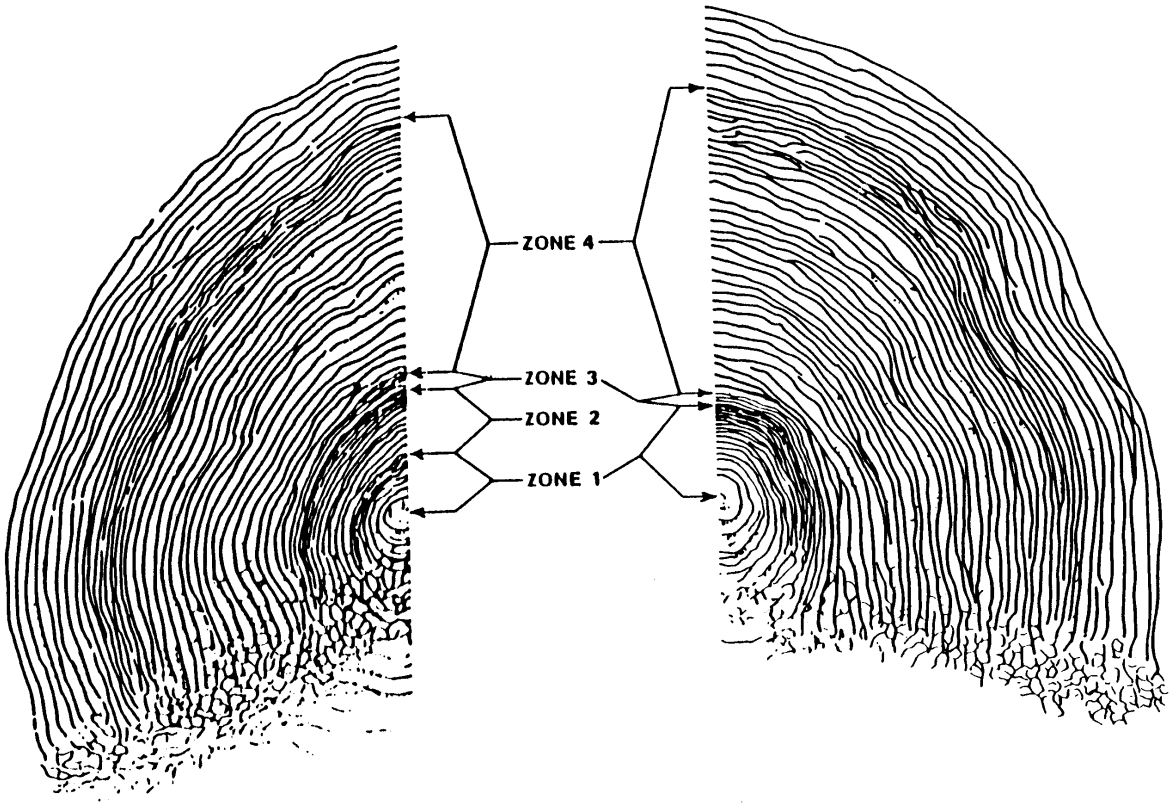

Figure 4. Typical scales with one and two freshwater growth zones showing the zones used for scale pattern analysis.

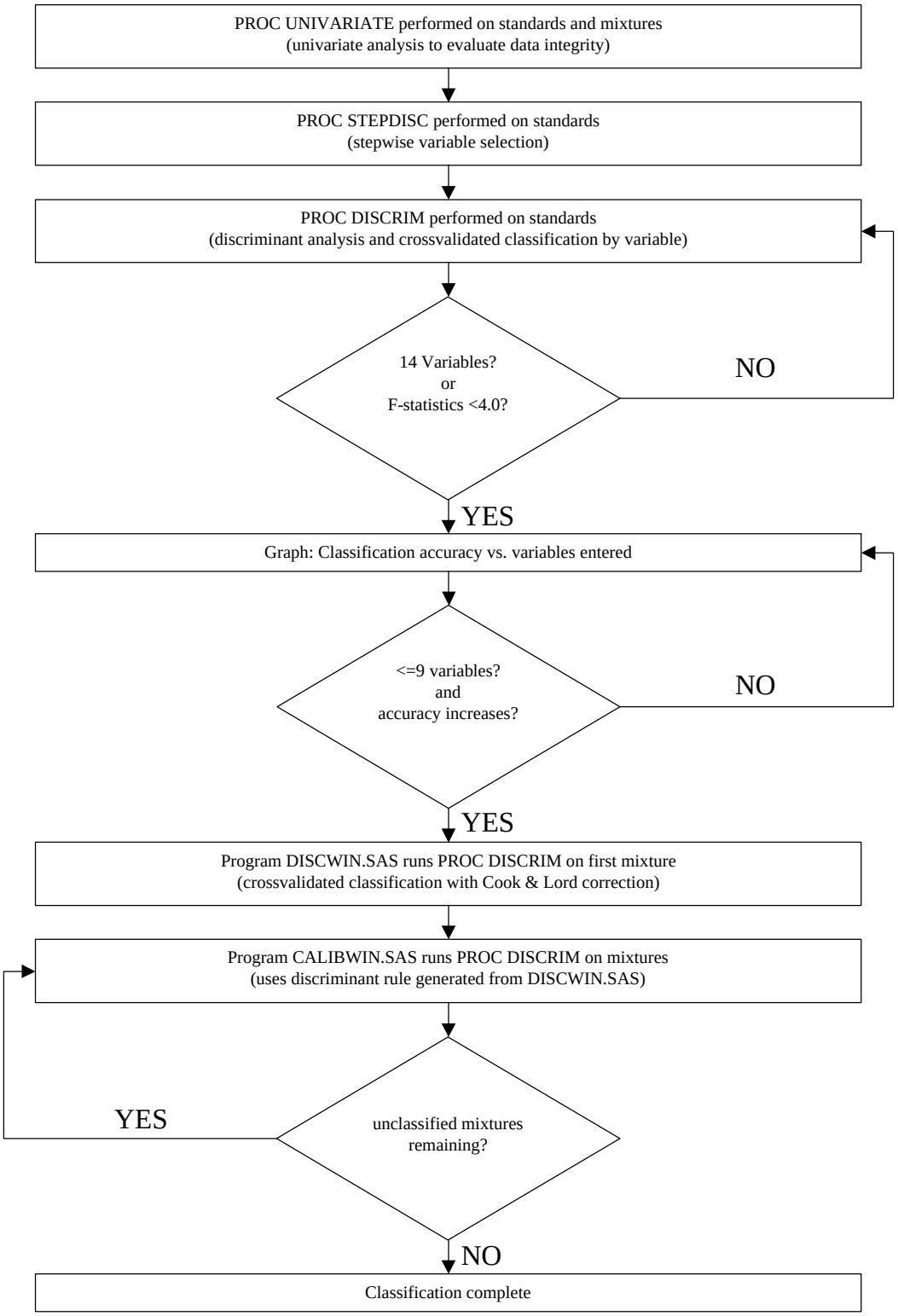

Figure 5. Schematic of the classification process utilizing SAS linear discriminant function procedures.

APPENDIX

Appendix A1. Digitized scale variables for use in SAS linear discriminant function analysis.

Variable	1st Freshwater Annular Zone
Z1*	Number of circuli (NC1FW)
Z2*	Width of zone (S1FW)
Z3*	Distance from scale focus (C0) to circulus 2 (C2)
Z4*	Distance from scale focus to circulus 4 (C0 - C4)
Z5*	Distance from scale focus to circulus 6 (C0 - C6)
Z6*	Distance from scale focus to circulus 8 (C0 - C8)
Z7	Distance from circulus 2 to circulus 4 (C2 - C4)
Z8	Distance from circulus 2 to circulus 6 (C2 - C6)
Z9	Distance from circulus 2 to circulus 8 (C2 - C8)
Z10	Distance from circulus 4 to circulus 6 (C4 - C6)
Z11	Distance from circulus 4 to circulus 8 (C4 - C8)
Z12*	Distance from fourth-to-last circulus to end of zone, C(NC1FW-4) - EOZ
Z13*	Distance from second-to-last circulus to end of zone, C(NC1FW-2) - EOZ
Z14	Distance from circulus 2 to end of zone (C2 - EOZ)
Z15	Distance from circulus 4 to end of zone (C2 - EOZ)
Z16	Relative width, (variable 3)/S1FW
Z17	Relative width, (variable 4)/S1FW
Z18	Relative width, (variable 5)/S1FW
Z19	Relative width, (variable 6)/S1FW
Z20	Relative width, (variable 7)/S1FW
Z21	Relative width, (variable 8)/S1FW
Z22	Relative width, (variable 9)/S1FW
Z23	Relative width, (variable 10)/S1FW
Z24	Relative width, (variable 11)/S1FW
Z25	Relative width, (variable 12)/S1FW
Z26	Relative width, (variable 13)/S1FW
Z27	Average interval between circuli (S1FW/NC1FW)
Z28*	Number of circuli in first 3/4 of zone
Z29*	Maximum distance between two consecutive circuli
Z30	Relative width, (variable 29)/S1FW

*discrete variables

-continued-

Variable	2nd Freshwater Annular Zone
Z31*	Number of circuli (NC2FW)
Z32*	Width of zone (S2FW)
Z33*	Distance from end of first annular zone (E1FW) to circulus 2 (C2)
Z34*	Distance from end of first annular zone to circulus 4 (E1FW - C4)
Z35*	Distance from end of first annular zone to circulus 6 (E1FW - C6)
Z36*	Distance from end of first annular zone to circulus 8 (E1FW - C8)
Z37	Distance from circulus 2 to circulus 4 (C2 - C4)
Z38	Distance from circulus 2 to circulus 6 (C2 - C6)
Z39	Distance from circulus 2 to circulus 8 (C2 - C8)
Z40	Distance from circulus 4 to circulus 6 (C4 - C6)
Z41	Distance from circulus 4 to circulus 8 (C4 - C8)
Z42*	Distance from fourth-to-last circulus to end of zone, C(NC2FW-4) - EOZ
Z43*	Distance from second-to-last circulus to end of zone, C(NC2FW-2) - EOZ
Z44	Distance from circulus 2 to end of zone (C2 - EOZ)
Z45	Distance from circulus 4 to end of zone (C4 - EOZ)
Z46	Relative width, (variable 33)/S2FW
Z47	Relative width, (variable 34)/S2FW
Z48	Relative width, (variable 35)/S2FW
Z49	Relative width, (variable 36)/S2FW
Z50	Relative width, (variable 37)/S2FW
Z51	Relative width, (variable 38)/S2FW
Z52	Relative width, (variable 39)/S2FW
Z53	Relative width, (variable 40)/S2FW
Z54	Relative width, (variable 41)/S2FW
Z55	Relative width, (variable 42)/S2FW
Z56	Relative width, (variable 43)/S2FW
Z57	Average interval between circuli (S2FW/NC2FW)
Z58*	Number of circuli in first 3/4 of zone
Z59*	Maximum distance between two consecutive circuli
Z60	Relative width, (variable 59)/S2FW

Variable	Freshwater Plus Growth Zone
Z61*	Number of circuli (NCPGZ)
Z62*	Width of zone (SPGZ)

Variable	All Freshwater Zones
Z63	Total number of annular circuli (NC1FW + NC2FW)
Z64	Total width of annular zones (S1FW + S2FW)
Z65	Total number of freshwater circuli (NC1FW + NC2FW + NCPGZ)
Z66	Total width of freshwater zones (S1FW + S2FW + SPGZ)
Z67	Relative width, S1FW/(S1FW + S2FW + SPGZ)
Z68	Relative width, SPGZ/(S1FW + S2FW + SPGZ)
Z69	Relative width, S2FW/(S1FW + S2FW + SPGZ)

*discrete variables

-continued-

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Variable	1st Marine Annular Zone
Z70*	Number of circuli (NC1OZ)
Z71*	Width of zone (S1OZ)
Z72*	Distance from end of freshwater growth (EFW) to circulus 3 (C3)
Z73*	Distance from end of freshwater growth to circulus 6 (EFW - C6)
Z74*	Distance from end of freshwater growth to circulus 9 (EFW - C9)
Z75*	Distance from end of freshwater growth to circulus 12 (EFW - C12)
Z76*	Distance from end of freshwater growth to circulus 15 (EFW - C15)
Z77	Distance from circulus 3 to circulus 6 (C3 - C6)
Z78	Distance from circulus 3 to circulus 9 (C3 - C9)
Z79	Distance from circulus 3 to circulus 12 (C3 - C12)
Z80	Distance from circulus 3 to circulus 15 (C3 - C15)
Z81	Distance from circulus 6 to circulus 9 (C6 - C9)
Z82	Distance from circulus 6 to circulus 12 (C6 - C12)
Z83	Distance from circulus 6 to circulus 15 (C6 - C15)
Z84	Distance from circulus 9 to circulus 15 (C9 - C15)
Z85*	Distance from sixth-to-last circulus to end of zone, C(NC1OZ-6) - EOZ
Z86*	Distance from third-to-last circulus to end of zone, C(NC1OZ-3) - EOZ
Z87	Distance from circulus 3 to end of zone (C3 - EOZ)
Z88	Distance from circulus 9 to end of zone (C9 - EOZ)
Z89	Distance from circulus 15 to end of zone (C15 - EOZ)
Z90	Relative width, (variable 72)/S1OZ
Z91	Relative width, (variable 73)/S1OZ
Z92	Relative width, (variable 74)/S1OZ
Z93	Relative width, (variable 75)/S1OZ
Z94	Relative width, (variable 76)/S1OZ
Z95	Relative width, (variable 77)/S1OZ
Z96	Relative width, (variable 78)/S1OZ
Z97	Relative width, (variable 79)/S1OZ
Z98	Relative width, (variable 80)/S1OZ
Z99	Relative width, (variable 81)/S1OZ
Z100	Relative width, (variable 82)/S1OZ
Z101	Relative width, (variable 83)/S1OZ
Z102	Relative width, (variable 84)/S1OZ
Z103	Relative width, (variable 85)/S1OZ
Z104	Relative width, (variable 86)/S1OZ
Z105	Average interval between circuli (S1OZ/NC1OZ)
Z106*	Number of circuli in first 1/2 of zone
Z107*	Maximum distance between two consecutive circuli
Z108	Relative width, (variable 107)/S1OZ

* discrete variables

Appendix A2. Scale variables with associated entry F-statistics and classification matrices for the LDF models used to classify sockeye catch in the District 101–103 net fisheries.

Age-1.2 Alaska/Nass/Skeena Model			
Variable	F-Statistic	Variable	F-Statistic
Z5	390.392	Z12	13.598
Z71	38.47	Z3	6.177

Classification Matrix for the Age 1.2 Alaska/Nass/Skeena Model

Frequency Row Percent	Alaska (Boundary)	Nass	Skeena
Alaska	170 89.01%	11 5.76%	10 5.24%
Nass	10 5.0%	164 82.0%	26 13.0%
Skeena	2 12.5%	1 6.25%	13 81.25%

Age 1.2 Alaska/Nass Model			
Variable	F-Statistic	Variable	F-Statistic
Z5	767.61	Z26	13.617
Z88	45.169	Z108	10.369
Z3	17.324	Z29	5.217
Z27	8.046	Z85	4.545

Classification Matrix for the Age 1.2 Alaska/Nass Model

Frequency Row Percent	Alaska	Nass
Alaska	179 93.23%	13 6.77%
Nass	11 5.5%	189 94.5%

Age 1.3 Alaska/Nass/Skeena Model			
Variable	F-Statistic	Variable	F-Statistic
Z5	348.138	Z27	8.916
Z71	69.044	Z2	17.033
Z82	15.401	Z17	8.674
Z97	13.406	Z104	7.404

-continued-

Classification Matrix for the 1.3 Alaska/Nass/Skeena Model

Frequency Row Percent	Alaska	Nass	Skeena
Alaska	177 88.06%	17 8.46%	7 3.48%
Nass	13 6.5%	128 64%	59 29.5%
Skeena	19 9.36%	40 19.7%	144 70.94%

Age 1.3 Alaska/Skeena Model			
Variable	F-Statistic	Variable	F-Statistic
Z5	470.537	Z86	14.708
Z71	98.235		

Classification Matrix for the Age 1.3 Alaska/Skeena Model

Frequency Row Percent	Alaska	Skeena
Alaska	189 94.03%	12 5.97%
Skeena	22 10.84%	181 89.16%

Age 2.2 Alaska/Nass Model			
Variable	F-Statistic	Variable	F-Statistic
Z66	427.225	Z35	20.794
Z27	87.004	Z107	19.9
Z13	31.507	Z16	11.586

Classification Matrix for the Age 2.2 Alaska/Nass Model

Frequency Row Percent	Alaska	Nass
Alaska	125 98.43%	2 1.57%
Nass	14 7.07%	184 92.93%

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Age 2.3 Alaska/Nass Model			
Variable	F-Statistic	Variable	F-Statistic
Z4	113.486	Z77	28.254
Z35	57.578	Z67	24.491

Classification Matrix for the Age 2.3 Alaska/Nass Model

Frequency Row Percent	Alaska	Nass
Alaska	125 90.58%	13 9.42%
Nass	16 16%	84 84%

Appendix A3. Scale variables with associated entry F-statistics and classification matrices for the LDF models used to classify sockeye salmon catch in the District 104 purse seine fishery.

Age 1.2 Alaska/Nass/Skeena/South-migrating Model			
Variable	F-Statistic	Variable	F-Statistic
Length	395.697	Z5	20.536
Z27	91.042	Z97	12.370
Z87	42.289	Z79	7.984
Z86	25.904	Z67	8.111

Classification Matrix for the Age 1.2 Alaska/Nass /Skeena/South-migrating Model

Frequency Row Percent	Alaska	Nass	Skeena	South-migrating
Alaska	177 94.65%	2 1.07%	5 2.67%	3 1.6%
Nass	1 .5%	153 76.5%	6 3%	40 20%
Skeena	1 6.25%	0 0%	13 81.25%	2 12.5%
South-migrating	1 .61%	33 20%	6 3.64%	125 75.76%

Age 1.2 Alaska/Nass/South-migrating Model			
Variable	F-Statistic	Variable	F-Statistic
Length	597.943	Z97	20.748
Z27	124.035	Z89	10.829
Z104	49.027	Z72	8.299
Z4	28.987	Z8	4.359

Classification Matrix for the Age 1.2 Alaska/Nass /South-migrating Model

Frequency Row Percent	Alaska	Nass	South-migrating
Alaska	184 98.4%	2 1.07%	1 .53%
Nass	2 1%	154 77%	44 22%
South-migrating	1 .61%	31 18.79%	133 80.61%

Age 1.2 Alaska/South-migrating Model			
Variable	F-Statistic	Variable	F-Statistic
Length	980.854	Z81	16.145
Z4	87.082	Z67	9.721
Z104	60.611		

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Classification Matrix for the Age 1.2 Alaska/South-migrating Model

Frequency Row Percent	Alaska	South-migrating
Alaska	184 98.4%	3 1.6%
South-migrating	3 1.82%	162 98.18%

Age 1.3 Alaska/Nass/Skeena Model			
Variable	F-Statistic	Variable	F-Statistic
Z5	399.727	Z82	24.174
Z87	83.103	Z97	16.124
Length	52.309	Z12	8.066

Classification Matrix for the Age 13 Alaska/Nass/Skeena Model

Frequency Row Percent	Alaska	Nass	Skeena
Alaska	184 92.46%	13 6.53%	2 1.01%
Nass	8 4%	138 69%	64 32%
Skeena	11 5.42%	43 21.18%	146 71.92%

Age 1.3Alaska/Skeena Model			
Variable	F-Statistic	Variable	F-Statistic
Z5	518.672	Z100	27.578
Length	138.145	Z16	15.139
Z82	81.962		

Classification Matrix for the Age 1.3 Alaska/Skeena Model

Frequency Row Percent	Alaska	Skeena
Alaska	193 96.98%	6 3.02%
Skeena	13 6.4%	190 93.6%

Age 2.2 Alaska/Nass Model			
Variable	F-Statistic	Variable	F-Statistic
Z57	457.196	Z56	34.981
Z3	117.242	Z21	35.213
Length	48.174	Z108	22.041
Z71	43.108	Z107	14.556

Classification Matrix for the Age 2.2 Alaska/Nass Model

Frequency Row Percent	Alaska	Nass
Alaska	169 98.26%	5 2.91%
Nass	6 3.03%	192 96.97%

Age 2.3 Alaska/Nass Model			
Variable	F-Statistic	Variable	F-Statistic
Z27	113.713	Z44	12.224
Z35	69.332	Z13	9.006
Z77	43.076	Z107	9.361
Z102	28.112	Z56	4.181

Classification Matrix for the Age 2.3 Alaska/Nass Model

Frequency Row Percent	Alaska	Nass
Alaska	151 92.64%	12 7.36%
Nass	13 13%	87 87%

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